


National Imaging Associates, Inc.* 	
Clinical guideline CERVICAL SPINE MRI	Original Date: September 1997
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INDICATIONS FOR CERVICAL SPINE MRI

⁺ If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be:

- Inconclusive or show a need for additional or follow up imaging evaluation OR**
- The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient.**

**(*Unless approvable in the combination section as noted in the guidelines——
(Combination requests at end of the document)**

For evaluation of neurologic deficits¹⁻⁶

~~(Acharya, 2019; ACR, 2013; NASS, 2010; Stolper, 2017; Teoli, 2021)~~

- With any of the following new neurological deficits documented on physical exam
 - Extremity muscular weakness **(and not likely caused by plexopathy, or peripheral neuropathy)**
 - Pathologic (e.g., Babinski, Lhermitte's sign, Chaddock Sign, Hoffman's) or abnormal reflexes
 - Absent/decreased sensory changes along a particular cervical dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature
 - Upper or lower extremity increase muscle tone/spasticity
 - New onset bowel or bladder dysfunction (e.g., retention or incontinence)- **not related to an inherent bowel or bladder process**
 - Gait abnormalities (see [Table 1](#) for more details)
- Suspected **cervical** cord compression with any neurological deficits as listed above
-

For evaluation of neck pain with any of the following⁷⁻⁹

~~(Allegri, 2016; AANSCNS, 2014; Jarvik, 2015)~~

- With new or worsening objective **neurologic deficits (as listed above)** on exam
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months¹⁰ ~~(ACR, 2013; Eubanks, 2010)~~
- With progression or worsening of symptoms during the course of conservative treatment*

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- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a cervical radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain. ~~(NASS, 2013)~~)¹¹
- Isolated neck pain in pediatric population^{12, 13} ~~(ACR, 2016)~~ – conservative care not required if red flags present ~~(see combination request below thoracic and lumbar spine may also be indicated)~~
 - Red flags that prompt imaging should include the presence of the following: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; ~~radicular pain;~~ fever; weight loss; ~~malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed~~^{14, 15} ~~(Bernstein, 2007; Feldman, 2006)~~
 - ~~Neck pain associated with suspected inflammation, infection, or malignancy~~

As part of initial **pre-operative / post-operative / procedural evaluation** (“CT best examination to assess for hardware complication, extent of fusion”^{12, 16} ~~(ACR, 2015; Rao, 2018)~~ and MRI for cord, nerve root compression, disc pathology or post-op infection)

- For preoperative evaluation/planning
- CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula))
- A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (routine surveillance post-op not indicated without symptoms)
- ~~Changing neurologic status post-operatively~~
- Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings
- **New or changing neurological deficits or symptoms post-operatively** ~~Residual or new neurological deficits or symptoms~~^{16, 17} ~~(Rao, 2018)~~– see **neurological deficit** section above
- When combo requests ~~(see above statement⁺)~~ – are submitted (e.g., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously (e.g., the need for both soft tissue and bony anatomy is required)¹⁸ ~~(Fisher, 2013)~~
 - Combination requests where both cervical spine CT and MRI cervical spine are both approvable (not an all-inclusive list):
 - OPLL (Ossification of posterior longitudinal ligament)¹⁹ ~~(Choi, 2011)~~
 - Pathologic or complex fractures
 - Malignant process of spine with both bony and soft tissue involvement
 - Unstable craniocervical junction
 - Clearly documented indication for bony and soft tissue abnormality where assessment will change management (i.e., surgical approach) for the patient

For evaluation of suspected myelopathy²⁰⁻²⁴

~~(ACR, 2015; Behrbalk, 2013; Davies, 2018; Sarbu, 2010; Vilaca, 2016)~~

- Does **NOT** require conservative care
- Progressive symptoms including hand clumsiness, worsening handwriting, difficulty with grasping and holding objects, diffuse numbness in the hands, pins and needles sensation, increasing difficulty with balance and ambulation
- Any of the [neurological deficits](#) as noted above

For evaluation of known or suspected multiple sclerosis (MS)^{20, 25-27}

~~(ACR, 2015; CSMS, 2018; Filippi, 2016; Kaunzner, 2017)~~

- Evidence of MS on recent baseline Brain MRI
- Suspected or known MS with new or changing symptoms consistent with cervical spinal cord disease (focal neurologic deficit or clinical sign, e.g., Lhermitte sign)
- Suspected or known pediatric demyelinating diseases (MS/ADEM)

~~• Suspected or known MS with new or changing symptoms consistent with cervical spinal cord disease (focal neurologic deficit or clinical sign, e.g., Lhermitte sign)~~

Combination studies MS²⁸ ~~(Barakat, 2015)~~

- These body regions might be evaluated separately or in combination as guided by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history (e.g., symptom(s), time course, and where in the CNS the likely localization(s) is/are), and other available information, including prior imaging.

- Cervical **and/or** Thoracic MRI for evaluation of **highly** suspected multiple sclerosis (MS) when Brain MRI **has indeterminate findings and/or** does not fulfill [the McDonald criteria for the diagnosis of MS](#)²⁶ ~~(Filippi, 2016)~~
- Cervical **and/or** Thoracic MRI with suspected transverse myelitis - with appropriate clinical symptoms (e.g., bilateral weakness, sensory disturbance, and autonomic dysfunction which typically evolve over hours or days)
- Brain MRI with Cervical **and/or** Thoracic MRI for evaluation of neuromyelitis optica spectrum disorders (recurrent or bilateral optic neuritis; recurrent transverse myelitis)²⁹ ~~(Wingerchuk, 2015)~~
- Known MS, entire CNS axis (Brain, **and/or** Cervical **and/or** Thoracic spine) is approvable prior to the initiation or change of disease modification treatments and assess disease burden (to establish a new baseline)
- Known MS- Follow-up scans, including brain and spine imaging, if patients have known spine disease:
- ~~Follow-up scans, including brain and spine imaging if patients have known spine disease:~~
 - 6-12 months after starting/changing treatment
 - Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years

For evaluation of trauma or acute injury^{12, 30}

~~(ACR, 2018)~~

- Presents with any of the following [neurological deficits](#) noted above

- With progression or worsening of symptoms during the course of [conservative treatment](#)*
 - History of underlying spinal abnormalities (i.e., ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis) ~~([Both MRI and CT are would be](#) approvable)~~³¹⁻³³ ([ACR, 2021; Koivikko, 2008; Taljanovic, 2009](#))
 - When the patient is clinically unevaluable or there are preliminary imaging findings (x-ray or CT) needing further evaluation
 - When office notes specify the patient meets NEXUS (National Emergency X-Radiography Utilization Study) or CCR (Canadian Cervical Rules) criteria for imaging:
 - CT for initial imaging
 - MRI when suspect spinal cord or nerve root injury or when patient is obtunded, and CT is negative
 - CT or MRI for treatment planning of unstable spine
- ("MRI and CT provide complementary information. When indicated it is appropriate to perform both examinations")³¹ ([ACR, 2018](#))

For evaluation of known or new compression fractures with worsening neck pain¹² ([ACR, 2018](#))

- With history of malignancy
 - To aid in differentiation of benign osteoporotic fractures from metastatic disease
 - A follow-up MRI in 6-8 weeks after initial MRI when initial imaging cannot decipher (indeterminate) benign osteoporotic fracture from metastatic disease (Kumar, 2016)
- With an associated new focal [neurologic deficit](#) as above³⁴ ([Alexandru, 2012](#))
- Prior to a planned surgery/intervention or if the results of the MRI will change management

For evaluation of tumor, cancer, or metastasis with any of the ~~following following~~:

(MRI is usually the preferred study, but CT may be needed to further characterize solitary indeterminate lesions seen on MRI)^{12, 35-37} ([ACR, 2018; Kim, 2012; Roberts, 2010](#))

• Primary tumor

- ○ Initial staging or re-staging of a known primary spinal tumor³⁸ ([NCCN 2021](#))
- ○ Known spinal tumor with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings)
- ○ With an associated new focal [neurologic deficit](#) as above³⁴ ([Alexandru, 2012](#))

• Metastatic tumor

- ○ With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam
- ~~Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine~~
- ○ With an associated new focal neurologic deficit³⁴ ([Alexandru, 2012](#))

- Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, radiculopathy or neck pain that occurs at night and wakes the patient from sleep with known active cancer, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine^{12, 39} ~~(ACR, 2018; Ziu, 2019)~~

- **For evaluation of inconclusive finding on prior imaging that requires further clarification**

- One follow-up exam to ensure no suspicious change has occurred in prior imaging finding. No further surveillance unless specified as highly suspicious or change was found on last follow-up exam¹² ~~(ACR, 2018)~~

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated, OR evaluation of suspected metastases

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine

For evaluation of known or suspected infection/abscess¹²

~~(ACR, 2018)~~

- Infection
 - As evidenced by signs and/or symptoms, laboratory (i.e., abnormal white blood cell count, ESR and/or CRP) or prior imaging findings⁴⁰ ~~(Bond, 2016)~~
 - Follow-up imaging of infection
 - With worsening symptoms/laboratory values (i.e., white blood cell count, ESR/CRP) or radiographic findings⁴¹ ~~(Berbari, 2015)~~

For evaluation of known or suspected inflammatory disease or atlantoaxial instability

- In rheumatoid arthritis with neurologic signs/symptoms, or evidence of subluxation on radiographs (lateral radiograph in flexion and neutral should be the initial study)^{42, 43} ~~(Colebatch, 2013; Tehranzadeh, 2017)~~
 - Patients with negative radiographs but symptoms suggestive of cervical instability or in patients with neurologic deficits MRI is indicated⁴⁴ ~~(Gillick, 2015)~~
- High-risk disorders affecting the atlantoaxial articulation, such as Down syndrome, Marfan syndrome with neurological signs/symptoms, abnormal neurological exam, or evidence of abnormal or inconclusive radiographs of the cervical spine⁴⁵ ~~(Henderson, 2017)~~
- Spondyloarthropathies, known or suspected
 - Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and appropriate rheumatology workup

For evaluation of spine abnormalities related to immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma^{46, 47}

~~(ACR, 2015; Nagashima, 2010)~~

- As evidenced by signs/symptoms, laboratory, or prior imaging findings

Other Indications for a Cervical Spine MRI

(Note- See [combination requests](#), below, for initial advanced imaging assessment and pre-operatively)

- Tethered cord or spinal dysraphism (known or suspected), based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata⁴⁸⁻⁵⁰ ([AANS, 2019](#); [Duz, 2008](#); [Milhorat, 2009](#))
- Known Arnold-Chiari syndrome (For initial imaging see combination below)
 - Known Chiari I malformation without syrinx or hydrocephalus, follow-up imaging after initial diagnosis with new or changing signs/symptoms or exam findings consistent with spinal cord pathology⁵¹ ([Hitson, 2015](#))
 - Known Chiari II (Arnold-Chiari syndrome), III, or IV malformation
- Achondroplasia (one Cervical Spine MRI to assess the craniocervical junction, as early as possible, even in asymptomatic cases)^{52, 53} ([Legare, 2020](#); [White, 2016](#))
- Syrinx or syringomyelia (known or suspected)
 - With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis⁵⁴ ([Timpone, 2015](#)))
 - To further characterize a suspicious abnormality seen on prior imaging
 - Known syrinx with new/worsening symptoms

• Toe walking in a child with signs/symptoms of myelopathy localized to the Cervical Spine

- ~~Toe walking in a child when associated with upper motor neuron signs, including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))~~ Suspected neuroinflammatory Conditions/Diseases (e.g., sarcoidosis, Behcet's)

• After detailed neurological exam and basic testing completed

COMBINATION OF STUDIES WITH CERVICAL SPINE MR

~~Indications for combination studies^{55, 56}: (ACR, 2017, 2019) — For approved indications as noted below and being performed in a child under 8 years of age who will need anesthesia for the procedure~~

Brain MRI/Cervical MRI

- For evaluation of known Arnold-Chiari Malformation

Cervical and Thoracic MRI

• Initial evaluation of known syrinx or syringomyelia

- With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis⁵⁴)
- To further characterize a suspicious abnormality seen on prior imaging
- Known syrinx with new/worsening symptom

Any combination of Cervical and/or Thoracic and/or Lumbar MRIs

Note: These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history, and other available information, including prior imaging.

Exception- Indications for combination studies^{55, 56}: Are approved indications as noted below and being performed in children who will need anesthesia for the procedure

• Any combination of these studies for:

- Survey/complete initial assessment in of infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10⁵⁷⁻⁵⁹ (e.g., congenital scoliosis, idiopathic scoliosis, scoliosis with vertebral anomalies)
- In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning⁶⁰
- Back pain with known vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging
- Scoliosis with any of the following⁶¹:
 - Progressive spinal deformity;
 - Neurologic deficit (new or unexplained);
 - Early onset;
 - Atypical curve (e.g., short segment, >30° kyphosis, left thoracic curve, associated organ anomalies);
 - Pre-operative planning; OR
 - When office notes clearly document how imaging will change management

• Arnold-Chiari malformations^{62, 63}

- Arnold-Chiari I
 - For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed^{50, 57}
- Arnold-Chiari II-IV - For initial evaluation and follow-up as appropriate
 - Usually associated with open and closed spinal dysraphism, particularly meningocele

• Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata,⁴⁸⁻⁵⁰ when anesthesia required for imaging⁶⁴ (e.g., meningocele, lipomenocele, diastematomyelia, fatty/thickened filum terminale, and other spinal cord malformations)

• Oncological applications (e.g., primary nervous system, metastatic)

- Drop metastasis from brain or spine (imaging also includes brain)- see [Overview section](#)
- Suspected leptomeningeal carcinomatosis (LC)⁶⁵ -see [Overview section](#)
- Any combination of these for spinal survey in patient with metastases
- Tumor evaluation and monitoring in neurocutaneous syndromes - See [Overview section](#)

- CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula))

~~Any combination of Cervical and/or Thoracic and/or Lumbar MRIs~~

- ~~Any combination of these studies for:~~
 - ~~Scoliosis survey in infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10⁵³⁻⁵⁵ (ACR, 2018; SRS, 2019; Strahle, 2015)~~
 - ~~In the presence of progressive spinal deformity or for preoperative planning⁵⁶ (Trenga, 2016)~~
 - ~~Neck pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging~~
 - ~~Scoliosis with any of the following⁵⁷ (Ozturk, 2010):~~
 - ~~Progressive spinal deformity;~~
 - ~~Neurologic deficit;~~
 - ~~Early onset;~~
 - ~~Atypical curve (e.g., short segment, >30° kyphosis, left thoracic curve, associated organ anomalies);~~
 - ~~Pre-operative planning; OR~~
 - ~~When office notes clearly document how imaging will change management~~
- ~~Arnold Chiari I^{58,59} (Radic, 2018; Strahle, 2011)~~
 - ~~For evaluation of spinal abnormalities associated with initial diagnosis of Arnold Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed^{46,55} (Milhorat, 2009; Strahle, 2015)~~
- ~~Arnold Chiari II-IV~~
 - ~~For initial evaluation and follow up as appropriate~~
- ~~Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata,⁴⁴⁻⁴⁶ (AANS, 2019; Duz, 2008; Milhorat, 2009), when anesthesia required for imaging⁶⁰ (Hertzler, 2010)~~
- ~~Toe walking in a child when associated with upper motor neuron signs including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))~~
- ~~Neck pain in a child with any of the following red flags (conservative care not required when red flags present):~~
 - ~~Red flags that prompt imaging should include the presence of age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed^{11, 12} (Bernstein, 2007; Feldman, 2006)~~
- ~~Drop metastasis from brain or spine (imaging also includes brain)~~
- ~~Suspected leptomeningeal carcinomatosis (LC)⁶¹ (Shah, 2011)~~
- ~~Any combination of these for spinal survey in patient with metastases~~

- ~~Tumor evaluation and monitoring in neurocutaneous syndromes – See Background~~
- ~~CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal venous fistula))~~

BACKGROUND

Magnetic resonance imaging (MRI) produces high quality multiplanar images of organs and structures within the body without radiation. It is the preferred modality for evaluating the internal structure of the spinal cord, providing assessment of conditions such as degenerative disc pathology, osteomyelitis, and discitis.

OVERVIEW

***Conservative Therapy** – (Spine) should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components, such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician-supervised home exercise program**, and/or osteopathic manipulative medicine (OMT) or chiropractic care when considered safe and appropriate.

****Home Exercise Program – (HEP)/ Therapy:** The following elements are required to meet guidelines for completion of conservative therapy^{66, 67} ~~(ACR, 2015; Last, 2009)~~:

- Information provided on exercise prescription/plan AND
- Follow-up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 6-week period), or inability to complete HEP due to physical reason- i.e., increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).
- Dates and duration of failed PT, physician-supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

Cervical myelopathy – Symptom severity varies, and a high index of suspicion is essential for making the proper diagnosis in early cases. Symptoms of pain and radiculopathy may not be present. The natural history of myelopathy is characterized by neurological deterioration. The most frequently encountered symptom is gait abnormality (86%) followed by increased muscular reflexes (79.1%), pathological reflexes (65.1%), paresthesia of upper limb (69.8%), and pain (67.4%) ~~(Vilaca, 2016)~~.²⁴

Infection, Abscess, or Inflammatory disease

- Infection:
 - Most common site is the lumbar spine (58%), followed by the thoracic spine (30%) and the cervical spine (11%)⁶⁸ ~~(Graeber, 2019)~~

- High risk populations (indwelling hardware, history of endocarditis, IVDA, recent procedures) with appropriate signs/symptoms

Table 1: Gait and spine imaging^{†69-74}

Gait	Characteristic	Work up/Imaging
Hemiparetic	Spastic unilateral, circumduction	Brain and/or, Cervical spine imaging based on associated symptoms
Diplegic	Spastic bilateral, circumduction	Brain, Cervical and Thoracic Spine imaging
Myelopathic	Wide based, stiff, unsteady	Cervical and/or Thoracic spine MRI based on associated symptoms
Ataxic	Broad based, clumsy, staggering, lack of coordination, usually also with limb ataxia	Brain imaging
Apraxic	Magnetic, shuffling, difficulty initiating	Brain imaging
Parkinsonian	Stooped, small steps, rigid, turning en bloc, decreased arm swing	Brain Imaging
Choreiform	Irregular, jerky, involuntary movements	Medication review, consider brain imaging as per movement disorder Brain MR guidelines
Sensory ataxic	Cautious, stomping, worsening without visual input (ie + Romberg)	EMG, blood work, consider spinal (cervical or thoracic cord imaging) imaging based on EMG
Neurogenic	Steppage, dragging of toes	<ul style="list-style-type: none"> • <u>EMG initial testing;</u> • <u>BUT if there is a foot drop, lumbar spine MRI is appropriate without EMG</u> • <u>Pelvis MR if there is evidence of plexopathy</u> • <u>EMG à foot drop Lumbar spine MRI</u> • <u>Pelvis MR appropriate evidence of plexopathy</u>
Vestibular	Insecure, veer to one side, worse when eyes closed, vertigo	Consider Brain/IAC MRI as per GL

([†]References: Chhetri, 2014; Clinch, 2021; Gait, 2021; Haynes, 2018; Marshall, 2012; Pirker, 2017)

MRI for Evaluation of Discitis – Discitis is a known complication of cervical discography. Postoperative discitis in the cervical spine does not occur frequently but can result from accidental inoculation of bacteria into the disc space intra-operatively by a contaminated spinal needle being used as a radiological marker. There may be other causes for postoperative discitis, e.g., esophageal perforation, hematogenous spread, inoculation of bacteria during surgery. Patients with an alteration in the nature of their symptoms after cervical discectomy and fusion may have discitis. Symptoms may include complaints of mild paresthesia in extremities and neck pain. MRI may be performed to reveal feature of discitis with associated abscesses and may help to confirm the diagnosis and decide on further management.

MRI for Cervical Radiculopathy – MRI is a useful test to evaluate the spine because it can show abnormal areas of the soft tissues around the spine; in addition to the bones, it can also show pictures of the nerves and discs and is used to find tumors, herniated discs, or other soft-tissue disorders. MRI has a role both in the pre-operative screening and post-operative assessment of radicular symptoms due to either disc or osteophyte.

Table 2: MRI and Cutaneous Stigmata⁷⁵ (Dias, 2015)

Risk Stratification for Various Cutaneous Markers		
High Risk	Intermediate Risk	Low Risk
<ul style="list-style-type: none"> Hypertrichosis Infantile hemangioma Atretic meningocele DST Subcutaneous lipoma Caudal appendage Segmental hemangiomas in association with LUMBAR[‡] syndrome 	<ul style="list-style-type: none"> Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined or PWS when darker red and well-defined) 	<ul style="list-style-type: none"> Coccygeal dimple Light hair Isolated café au lait spots Mongolian spots Hypo- and hypermelanotic macules or papules Deviated or forked gluteal cleft Nonmidline lesions
[‡] LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.		

MRI and Multiple Sclerosis (MS) – MRI is a sensitive method of detecting the white matter lesions of MS. These plaques on MRI generally appear as multiple, well-demarcated, homogeneous, small ovoid lesions which often lack mass effect and are oriented perpendicular to the long axis of the lateral ventricles. Sometimes they present as large, space occupying lesions that may be misinterpreted as tumors, abscesses, or infarcts.

MRI and Neck Pain – Neck pain is common in the general population and usually relates to musculoskeletal causes, but it may also be caused by spinal cord tumors. When neck pain is accompanied by extremity weakness, abnormal gait, or asymmetric reflexes, spinal MRI may be performed to evaluate the cause of the pain. MRI may reveal areas of cystic expansion within the spinal cord. Enhancement with gadolinium contrast may suggest that the lesion is neoplastic.

Ossification Posterior Longitudinal Ligament (OPLL)¹⁹ ~~(Choi, 2011)~~ – Most common in cervical spine (rare but more severe in thoracic spine)

Back Pain with Cancer History – Bone is the third most common site of metastases after the liver and the lungs, and approximately two-thirds of all osseous metastases occur in the spine. Approximately 60–70% of patients with systemic cancer will have spinal metastasis. Radiographic (x-ray) examination should be performed in cases of back pain when a patient has a cancer history, but without known active cancer or a tumor that tends to metastasize to the spine. This can make a diagnosis in many cases. This may occasionally allow for selection of bone scan in lieu of MRI in some cases. When radiographs do not answer the clinical question, then MRI may be appropriate after a consideration of conservative care.

“Neoplasms causing VCF (vertebral compression fractures) include: primary bone neoplasms, such as hemangioma or giant cell tumors, and tumor-like conditions causing bony and cellular remodeling, such as aneurysmal bone cysts, or Paget’s disease (osteitis deformans); infiltrative neoplasms, including and not limited to, multiple myeloma and lymphoma, and metastatic neoplasms ~~(ACR, 2018)~~.”⁷⁶

Most common spine metastasis involving primary metastasis originate from the following tumors in descending order: breast (21%), lung (19%), prostate (7.5%), renal (5%), gastrointestinal (4.5%), and thyroid (2.5%). While all tumors can seed to the spine, the cancers mentioned above metastasize to the spinal column early in the disease process. Spinal metastasis is more commonly found in the thoracic region, followed by the lumbar region, while the cervical region is the least likely site of metastasis ~~(Ziu, 2019)~~.³⁹

Cervical Spine Trauma Imaging³⁰ ~~(ACR, 2018)~~ – The National Emergency X-Radiography Utilization Study (NEXUS) and the Canadian Cervical Rules (CCR) represent clinical criteria used to help determine the presence of significant cervical spine injury. Although the criteria are highly sensitive (99.6% for NEXUS), specificity is low (12.9% for Nexus).

A patient not meeting any of the NEXUS criteria of focal neurologic deficit, midline spinal tenderness, altered consciousness, intoxication, or distracting injury is unlikely to have a significant cervical spine injury. Imaging evaluation of the cervical spine in these patients is not necessary. In the CCR criteria, a patient without any high risk factors (Age >65 years; paresthesias in extremities; dangerous mechanism; falls from ≥3 feet/5 stairs; axial load to head; motor vehicle crash with high speed, rollover, or ejection; bicycle collision; motorized recreational vehicle accident) is next evaluated for low risk factors (Simple rear-end motor vehicle crash, patient in sitting position in emergency center, patient ambulatory at any time after trauma, delayed onset of neck pain, absence of midline cervical

spine tenderness). If the patient meets a low-risk criteria, they are asked to move their head 45 degrees from midline in both directions. If the patient can accomplish this, the spine is cleared, and imaging is not necessary.

MRI and Neurocutaneous Syndromes

- In NF-1, clinical evaluation appears to be more useful to detect complications than is screening imaging in asymptomatic patients. Imaging is indicated in evaluation of suspected tumors based on clinical evaluation and for follow-up of known intracranial tumors [\(Borofsky, 2013\)](#).⁷⁷
- Conversely in NF-2, routine MR imaging screening is always indicated, given the high prevalence of CNS tumors, especially vestibular schwannomas. In patients with NF-2, routine screening brain/IAC imaging is indicated annually starting from age 10, if asymptomatic, or earlier with clinical signs/symptoms. Most individuals with NF2 eventually develop a spinal tumor, mostly commonly schwannomas, but meningioma and ependymomas are also seen. Spinal imaging at baseline and every 2 to 3 years is also advised with more frequent imaging, if warranted, based on sites of tumor involvement [\(Evans, 2017\)](#).⁷⁸
- In patients with Tuberous Sclerosis, Brain MRI should be obtained every 1-3 years up until age 25 for surveillance for CNS abnormalities [\(Krueger, 2013\)](#).⁷⁹
- In Von Hippel Lindau Syndrome, imaging of the brain and spinal cord for hemangioblastomas is recommended every 2 years [\(Varshney, 2017\)](#).⁸⁰
- In Sturge Weber Syndrome, Brain MRI can rule out intracranial involvement after only age 1 and is recommended in patients <1 year old only if symptomatic [\(Comi, 2011\)](#).⁸¹

Drop Metastases⁸² —

Drop metastases are intradural extramedullary spinal metastases that arise from intracranial lesions. Common examples of intracranial neoplasms that result in drop metastases include pineal tumors, ependymomas, medulloblastomas, germinomas, primitive neuroectodermal tumors (PNET), glioblastomas multiform, anaplastic astrocytomas, oligodendrogliomas, and less commonly choroid plexus neoplasms and teratomas.

Leptomeningeal Carcinomatosis⁸³ —

Leptomeningeal carcinomatosis is complication of cancer in which cancerous cells spread to the membranes (meninges) that covers the brain and spinal cord. The most common solid tumors that involve the leptomeninges are breast, lung, and melanoma, gastrointestinal, and primary central nervous system tumors.

POLICY HISTORY

Date	Summary
March 2022	<p><u>Added</u></p> <ul style="list-style-type: none"> • <u>Combination request for overlapping body part statement</u> • <u>Clarified muscle weakness no related to plexopathy or peripheral neuropathy</u>

	<ul style="list-style-type: none"> • <u>Clarified bowel and bladder dysfunction – not related to an inherent bowel or bladder problem</u> • <u>Clarified isolated neck pain in pediatric patient</u> • <u>Clarified combination MS for cervical and/or thoracic spine combination requests</u> • <u>Added subsection for cervical and thoracic spine section for syrinx and syringomyelia</u> • <u>Descriptions for tethered cord</u> • <u>Background section of Drop Metastases</u> • <u>Background section of Leptomeningeal Carcinomatosis</u> • <u>Clarified toe walking in pediatric patient with myelopathy for cervical spine</u> <p><u>Removed</u></p> <ul style="list-style-type: none"> • <u>Removed from combination section syrinx and syringomyelia and added subsection for cervical and thoracic spine section</u> — <u>Removed pediatric back pain from the total spine combination section</u> • <u> </u>
<u>November 2021</u>	<ul style="list-style-type: none"> • <u>Added +0698T</u>
April 2021	<ul style="list-style-type: none"> • Added/modified <ul style="list-style-type: none"> ○ Modified section on neurological deficits ○ Back pain in a child added/modified red flags ○ Gait table in background ○ Post-surgical modified/clarified surgical criteria for combination exams and surgeon preference for exam type ○ Removed myelopathy combination studies ○ Updated/added MS Criteria <ul style="list-style-type: none"> ▪ Combination section for initial imaging and follow up ▪ Added pediatric MS ○ Modified known tumor imaging into primary and metastatic disease ○ Added toe walking for pediatric patients ○ Modified Combination exam wording ○ Added Achondroplasia to criteria
May 2020	<ul style="list-style-type: none"> • Added: <ul style="list-style-type: none"> ○ For evaluation of neurologic deficits are new ○ Added Imaging of Ossification of the Posterior Longitudinal Ligament (OPPL) ○ Added imaging in high risk patients predisposed to spinal injury

	<ul style="list-style-type: none"> ○ Added imaging in high risk patients for atlantoaxial injury ○ Added transverse myelitis ○ Modified Initial imaging of new or increasing non-traumatic neck pain or radiculopathy or neck pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine ○ Added to background of imaging of infection ○ Added Osteopathic Manipulative medicine to conservative care therapy
June 2019	<ul style="list-style-type: none"> • Added: <ul style="list-style-type: none"> ○ new or worsening objective neuro deficits for chronic and acute back pain ○ CSF leak ○ last 6 months for allowable post op f/u period and removed EMG comment ○ red flags specifically for peds back pain and pain related to malignancy, infection, inflammation ○ new sections: pars defect; compression fractures; congenital abnormalities including section on scoliosis and vertebral anomalies in children w/back pain; ○ For combination studies cervical/thoracic/lumbar added drop metastasis, tumor evaluation for neurocutaneous syndromes, and abnormalities associated w/Arnold Chiari, as well as separate indication for tethered cord or spinal dysraphism • Improved section for evaluation of multiple sclerosis including NMO disorders and recurrent transverse myelitis; Lhermitte sign • Modified section on evaluation of neurologic deficits; added specific pathologic findings; spasticity, sensory, or motor level changes • Included signs in section on myelopathy including hyperreflexia and pathologic reflexes • Enhanced sections on trauma; rheumatoid arthritis; back pain in cancer patients with known active cancer in tumors that tend to metastasize to spine • Expanded on tethered cord in Other Indications for imaging and added section on sacral dimple • For combination studies Brain/Cervical Spine added suspected MS with new or changing symptoms and follow up to initiation of treatment with known MS

REFERENCES

- Acharya AB, Fowler JB. Chaddock Reflex. Updated 2019 Dec 15. In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan.
- AIUM Practice Parameter for the Performance of an Ultrasound Examination of the Neonatal Spine. 2016.
- Alexandru D. Evaluation and management of vertebral compression fractures. *Perm J*. Published online October 30, 2012;46-51. doi:10.7812/TPP/12-037.
- Allegri M, Montella S, Salici F, et al. Mechanisms of low back pain: A guide for diagnosis and therapy v.2. *F100Res*. 2016; 5.
- American Association of Neurological Surgeons (AANS). Tethered spinal cord syndrome. 2019.
- American Association of Neurological Surgeons and Congress of Neurological Surgeons (AANSCNS). Choosing Wisely®. <http://www.choosingwisely.org/clinician-lists/american-association-neurological-surgeons-imaging-for-nonspecific-acute-low-back-pain/>. Released June 24, 2014.
- American College of Radiology (ACR). ACR Appropriateness Criteria®. <https://acsearch.acr.org/list>. 2015.
- American College of Radiology (ACR). ACR Appropriateness Criteria®. Cervical Neck Pain or Cervical Radiculopathy. <https://acsearch.acr.org/docs/69426/Narrative/>. Revised 2018.
- American College of Radiology (ACR). ACR Appropriateness Criteria®. Inflammatory Back Pain: Known or Suspected Axial Spondyloarthritis. <https://acsearch.acr.org/docs/3094107/Narrative/>. Revised 2021.
- American College of Radiology (ACR). ACR Appropriateness Criteria®. Suspected Spine Trauma. 2018.
- Barakat N, Gorman MP, Benson L, Becerra L, Borsook D. Pain and spinal cord imaging measures in children with demyelinating disease. *Neuroimage Clin*. 2015;9:338-347. doi:10.1016/j.nicl.2015.08.019.
- Behrbalk E, Salame K, Regev GJ, et al. Delayed diagnosis of cervical spondylotic myelopathy by primary care physicians. *Neurosurg Focus*. July 2013; 35(1):E1.
- Berberi EF, Kanj SS, Kowalski TJ, et al. 2015 Infectious Diseases Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adults. *Clin Infect Dis*. 2015 Sep 15; 61(6):e26-e46.
- Bernstein RM, Cozen H. Evaluation of back pain in children and adolescents. *Am Fam Physician*. 2007;76(11):1669-1676.

~~Bond A, Manian FA. Spinal epidural abscess: A review with special emphasis on earlier diagnosis. *Biomed Res Int*. 2016; 2016:1614328.~~

~~Borofsky S, Levy LM. Neurofibromatosis: Types 1 and 2. *Am J Neuroradiol*. 2013; 34(12):2250-2251.~~

~~Braga-Baiak A, Shah A, Pietrobon R, et al. Intra- and inter-observer reliability of MRI examination of intervertebral disc abnormalities in patients with cervical myelopathy. [Published online ahead of print May 25, 2007]. *Eur J Radiol*. 2008; 65(1):91-98. doi:10.1016/j.ejrad.2007.04.014.~~

~~Chhetri SK, Gow D, Shaunak S, Varma A. Clinical assessment of the sensory ataxias; diagnostic algorithm with illustrative cases. *Pract Neurol*. 2014;14(4):242-251. doi:10.1136/practneurol-2013-000764.~~

~~Choi JH, Lee T, Kwon HH, et al. Outcome of ultrasonographic imaging in infants with sacral dimple. *Korean J Pediatr*. 2018 Jun; 61(6): 194-199.~~

~~Choi BW, Song KJ, Chang H. Ossification of the posterior longitudinal ligament: A review of literature. *Asian Spine J*. 2011; 5(4):267-276. doi:10.4184/asj.2011.5.4.267.~~

~~Clinch J, Wood M, Driscoll S. Evaluation of gait disorders in children. BMJ Best Practice. Published February 23, 2021. Accessed July 14, 2021. <https://bestpractice.bmj.com/topics/en-us/709>.~~

~~Colebatch AN, Edwards CJ, Østergaard M, et al. EULAR recommendations for the use of imaging of the joints in the clinical management of rheumatoid arthritis. *Ann Rheum Dis*. 2013 Jun; 72(6):804-14.~~

~~Comi AM. Presentation, diagnosis, pathophysiology, and treatment of the neurological features of Sturge-Weber syndrome. *Neurologist*. 2011; 17(4):179.~~

~~Consortium of Multiple Sclerosis Centers (CMSC). 2018 Revised guidelines of the consortium of MS centers MRI protocol for the diagnosis and follow up of MS. 2018. https://cdn.ymaws.com/www.mscares.org/resource/collection/9C5F19B9-3489-48B0-A54B-623A1ECEE07B/2018MRIGuidelines_booklet_with_final_changes_0522.pdf. Retrieved July 15, 2021.~~

~~D' Alessandro. Does This Sacral Dimple Need to be Evaluated? *PediatricEducation.org*™. Iowa City, IA; July 20, 2009. <https://pediatriceducation.org/2009/07/20/does-this-sacral-dimple-need-to-be-evaluated/>. Retrieved March 29, 2018.~~

~~Davies BM, Smith EK. Degenerative cervical myelopathy. *BMJ*. 2018; 360 doi: <https://doi.org/10.1136/bmj.k186>.~~

~~Diab M, Landman Z, Lubicky J, et al. Use and outcome of MRI in the surgical treatment of adolescent idiopathic scoliosis. *Spine (Phila Pa 1976)*. April 15, 2011; 36(8):667-671. doi: 10.1097/BRS.0b013e3181da218c.~~

Dias M, Partington M. Congenital brain and spinal cord malformations and their associated cutaneous markers. *Pediatrics*. 2015; 136(4):e1105-19.

Dow G, Biggs N, Evans G, et al. Spinal tumors in neurofibromatosis type 2: Is emerging knowledge of genotype predictive of natural history? *Neurosurg Spine*. 2005; 2(5):574.

Duz B, Gocmen S, Secer HI, et al. Tethered cord syndrome in adulthood. *J Spinal Cord Med*. 2008; 31(3):272-278. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2565560/>. Retrieved March 29, 2018.

Eubanks JD. Cervical radiculopathy: Nonoperative management of neck pain and radicular symptoms. *Am Fam Physician*. 2010 Jan 1; 81(1):33-40. <https://www.aafp.org/afp/2010/0101/p33.pdf>

Evans DGR, Salvador H, Chang VY, et al. Tuberous sclerosis complex surveillance and management: Recommendations of the 2012 International Tuberous Sclerosis Complex Consensus Conference. *Clin Cancer Res*. 2017; 23(12):e54.

Feldman DS, Straight JJ, Badra MI, Mohaideen A, Madan SS. Evaluation of an algorithmic approach to pediatric back pain. *J Pediatr Orthop*. 2006;26(3):353-357. doi:10.1097/01.bpo.0000214928.25809.f9.

Filippi M, Rocca MA, Ciccarelli O, et al. MRI criteria for the diagnosis of multiple sclerosis: MAGNIMS consensus guidelines. *Lancet Neurol*. March 2016; 15(3):292-303. doi: 10.1016/S1474-4422(15)00393-2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4760851/>. Retrieved May 8, 2018.

Fisher BM, Cowles S, Matulich JR, et al. Is magnetic resonance imaging in addition to a computed tomographic scan necessary to identify clinically significant cervical spine injuries in obtunded blunt trauma patients? *Am J Surg*. 2013 Dec; 206(6):987-93; discussion 993-4. doi: 10.1016/j.amjsurg.2013.08.021. Epub 2013 Oct 10.

Gait abnormalities. Stanford Medicine 25. Published 2021. Accessed July 14, 2021. <https://stanfordmedicine25.stanford.edu/the25/gait.html>.

Gillick JL, Wainwright J, Das K. Rheumatoid arthritis and the cervical spine: A review on the role of surgery. *Int J Rheumatol*. 2015; 2015:252456. Epub 2015 Aug 17.

Goh C, Phal PM, Desmond PM. Neuroimaging in acute transverse myelitis. *Neuroimaging Clin N Am*. 2011 Nov; 21(4):951-73.

Graeber A, Cecava ND. Vertebral Osteomyelitis. [Updated 2019 Jun 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan.

Haynes KB, Wimberly RL, VanPelt JM, Jo C-H, Riccio AI, Delgado MR. Toe walking: A neurological perspective after referral from pediatric orthopaedic surgeons. *Journal of Pediatric Orthopaedics*. 2018;38(3):152-156. doi:10.1097/BPO.0000000000001115.

~~Henderson FC, Austin C, Benzel E. Neurological and spinal manifestations of the Ehlers-Danlos syndromes. *Am J Med Genet C Semin Med Genet*. 2017 Mar; 175(1):195-211.~~

~~Hertzler DA, DePowell JJ, Stevenson CB, Mangano FT. Tethered cord syndrome: A review of the literature from embryology to adult presentation. *Neurosurg Focus*. 2010;29(1):E1. doi:10.3171/2010.3.FOCUS1079.~~

~~Hitson WJ, Lane JR, Bauer DF, et al. A prospective natural history study of nonoperatively managed Chiari I malformation: Does follow-up MRI surveillance alter surgical decision making? *J Neurosurg Pediatr*. 2015 Aug; 16(2):159-66.~~

~~Jarvik JG, Gold LS, Comstock BA, et al. Association of early imaging for back pain with clinical outcomes in older adults. *JAMA*. 2015; 313(11):1143-1153. doi: 10.1001/jama.2015.1871.~~

~~Jensen AO, Jacobsen JB, Norgaard M, et al. Incidence of bone metastases and skeletal related events in breast cancer patients: a population-based cohort study in Denmark. *BMC Cancer*. January 24, 2011; 11:29. <http://www.ncbi.nlm.nih.gov/pubmed/21261987>.~~

~~Kaunzner UW, Gauthier SA. MRI in the assessment and monitoring of multiple sclerosis: An update on best practice. *Ther Adv Neurol Disord*. 2017;10(6):247-261. doi:10.1177/1756285617708911.~~

~~Kim YS, Han IH, Lee IS, et al. Imaging findings of solitary spinal bony lesions and the differential diagnosis of benign and malignant lesions. *J Korean Neurosurg Soc*. August 2012; 52(2): 126-132. doi: 10.3340/jkns.2012.52.2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3467370/>. Retrieved March 29, 2018.~~

~~Koivikko MP, Koskinen SK. MRI of cervical spine injuries complicating ankylosing spondylitis. *Skeletal Radiol*. 2008; 37(9):813-819. doi: 10.1007/s00256-008-0484-x.~~

~~Krueger DA, Northrup H. Tuberous sclerosis complex surveillance and management: Recommendations of the 2012 International Tuberous Sclerosis Complex Consensus Conference. *Pediatr Neurol*. 2013; 49(4):255.~~

~~Kumar Y, Hayashi D. Role of magnetic resonance imaging in acute spinal trauma: A pictorial review. *BMC Musculoskelet Disord*. 2016; 17:310.~~

~~Last AR, Hulbert K. Chronic low back pain: Evaluation and management. *Am Fam Physician*. 2009; 79(12):1067-74.~~

~~Legare JM. Achondroplasia. In: Adam MP, Ardinger HH, Pagon RA, et al., eds. *GeneReviews*®. University of Washington, Seattle; 1993. Accessed July 16, 2021. <http://www.ncbi.nlm.nih.gov/books/NBK1152/> [Updated August 6, 2020].~~

~~Marshall FJ. Approach to the elderly patient with gait disturbance. *Neurol Clin Pract*. 2012;2(2):103-111. doi:10.1212/CPJ.0b013e31825a7823.~~

~~Milhorat TH, Bolognese PA, Nishikawa M, et al. Association of Chiari malformation type I and tethered cord syndrome: Preliminary results of sectioning filum terminale. *Surg Neurol*. July 1, 2009. 72(1):20-35. <http://europepmc.org/abstract/med/19559924>. Retrieved March 29, 2018.~~

~~Nagashima H, Yamane K, Nishi T, et al. Recent trends in spinal infections: Retrospective analysis of patients treated during the past 50 years. *Int Orthop*. March 2010; 34(3):395-399. doi: 10.1007/s00264-009-0741-1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2899281/>. Retrieved May 8, 2018.~~

~~North American Spine Society (NASS). Evidence-based Clinical Guidelines for Multidisciplinary Spine Care. Diagnosis and Treatment of Cervical Radiculopathy from Degenerative Disorders. 2010 North American Spine Society. <https://www.spine.org/Portals/0/Assets/Downloads/ResearchClinicalCare/Guidelines/CervicalRadiculopathy.pdf>~~

~~North American Spine Society (NASS). Clinician Lists. Choosing Wisely®. <http://www.choosingwisely.org/clinician-lists/nass-emg-nerve-conduction-studies-to-determine-cause-of-spine-pain/>. Released October 9, 2013.~~

~~North American Spine Society (NASS). Five Things Physicians and Patients Should Question. <http://www.choosingwisely.org/doctor-patient-lists/north-american-spine-society/>. 2014.~~

~~Öztürk C, Karadereler S, Örnek I, Enercan M, Ganiyusufoglu K, Hamzaoglu A. The role of routine magnetic resonance imaging in the preoperative evaluation of adolescent idiopathic scoliosis. *Int Orthop*. 2010;34(4):543-546. doi:10.1007/s00264-009-0817-y.~~

~~Pirker W, Katzenschlager R. Gait disorders in adults and the elderly: A clinical guide. *Wien Klin Wochenschr*. 2017;129(3-4):81-95. doi:10.1007/s00508-016-1096-4.~~

~~Radic JAE, Cochrane DD. Choosing wisely canada: pediatric neurosurgery recommendations. *Paediatr Child Health*. 2018;23(6):383-387. doi:10.1093/pch/pxy012.~~

~~Rao D, Scuderi G, Scuderi C, Grewal R, et al. The use of imaging in management of patients with low back pain. *J Clin Imaging Sci*. 2018 Aug 24; 8:30.~~

~~Rednam SP, Erez A, Druker H, et al. Von Hippel-Lindau and Hereditary Pheochromocytoma/Paraganglioma syndromes: Clinical features, genetics, and surveillance recommendations in childhood. *Clin Cancer Res*. 2017; 23(12):e68.~~

~~Roberts CC, Daffner RH, Weissman BN, et al. ACR Appropriateness Criteria® on metastatic bone disease. *J Am Coll Radiol*. 2010;7(6):400-409. doi:10.1016/j.jacr.2010.02.015.~~

Sarbu N, Lolli V, Smirniotopoulos JG. Magnetic resonance imaging in myelopathy: A pictorial review. *Clin Imaging*. 2019 Sep-Oct; 57:56-68. doi: 10.1016/j.clinimag.2019.05.002. Epub 2019 May 17.

Scoliosis Research Society (SRS). Conditions and treatments: Juvenile scoliosis. 2019.

Shah LM, Salzman KL. Imaging of spinal metastatic disease. *Int J Surg Oncol*. 2011; 2011:769753.

Stolper K, Haug JC, Christensen CT, et al. Prevalence of thoracic spine lesions masquerading as cauda equina syndrome: Yield of a novel magnetic resonance imaging protocol. *Intern Emerg Med*. 2017 Dec; 12(8):1259-1264. doi: 10.1007/s11739-016-1565-9.

Strahle J, Muraszko KM, Kapurch J, Bapuraj JR, Garton HJL, Maher CO. Chiari malformation Type I and syrinx in children undergoing magnetic resonance imaging. *J Neurosurg Pediatr*. 2011;8(2):205-213. doi:10.3171/2011.5.PEDS1121.

Strahle J, Smith BW, Martinez M, et al. The association between Chiari malformation Type I, spinal syrinx, and scoliosis. *J Neurosurg Pediatr*. 2015; 15:607-611.
<http://thejns.org/doi/pdf/10.3171/2014.11.PEDS14135>. Retrieved March 29, 2018.

Taljanovic MS, Hunter TB, Wisneski RJ, et al. Imaging characteristics of diffuse idiopathic skeletal hyperostosis with an emphasis on acute spinal fractures: Review. *AJR Am J Roentgenol*. 2009;193(3 Suppl):S10-19, Quiz S20-24. doi:10.2214/AJR.07.7102.

Tehranzadeh J, Ashikyan O, Dascalos J, et al. Cervical spine instability in the course of rheumatoid arthritis—imaging methods. *Reumatologia*. 2017; 55(4):201-207.

Teoli D, Cabrero FR, Ghassemzadeh S. Lhermitte Sign. [Updated 2020 Oct 23]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK493237/>.

Timpone V, Patel SH. MRI of a syrinx: Is contrast material always necessary? *Am J Roentgenol*. 2015; 204:1082-1085. 10.2214/AJR.14.13310.

Trenga AP, Singla A, Feger MA, et al. Patterns of congenital bony spinal deformity and associated neural anomalies on X-ray and magnetic resonance imaging. *J Child Orthop*. August 2016; 10(4):343-352. doi: 10.1007/s11832-016-0752-6. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4940247/>. Retrieved March 29, 2018.

Varshney N, Kebede AA, Owusu-Dapaah H, Lather J, Kaushik M, Bhullar JS. A review of Von Hippel-Lindau Syndrome. *J Kidney Cancer VHL*. 2017;4(3):20-29. doi:10.15586/jkcvhl.2017.88.

Vilaca C, Orsini M, Araujo-Leite MA, et al. Cervical spondylotic myelopathy: What the neurologist should know. *Neurol Int*. 2016 Nov 2; 8(4): 6330. doi: 10.4081/ni.2016.6330.

~~White KK, Bompadre V, Goldberg MJ, et al. Best practices in the evaluation and treatment of foramen magnum stenosis in achondroplasia during infancy. *Am J Med Genet*. 2016;170(1):42-51. doi:10.1002/ajmg.a.37394.~~

~~Wingerchuk DM, Banwell B, Bennett JL, et al. International consensus diagnostic criteria for neuromyelitis optica spectrum disorders. *Neurology*. 2015 Jul 14; 85(2).~~

~~Ziu E, Mesfin FB. Cancer, Spinal Metastasis. *StatPearls(Internet)*. April 23, 2019.~~

~~Reviewed / Approved by NIA Clinical Guideline Committee~~

GENERAL INFORMATION

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.

Disclaimer: Magellan Healthcare service authorization policies do not constitute medical advice and are not intended to govern or otherwise influence the practice of medicine. These policies are not meant to supplant your normal procedures, evaluation, diagnosis, treatment and/or care plans for your patients. Your professional judgement must be exercised and followed in all respects with regard to the treatment and care of your patients. These policies apply to all Magellan Healthcare subsidiaries including, but not limited to, National Imaging Associates ("Magellan"). The policies constitute only the reimbursement and coverage guidelines of Magellan. Coverage for services varies for individual members in accordance with the terms and conditions of applicable Certificates of Coverage, Summary Plan Descriptions, or contracts with governing regulatory agencies. Magellan reserves the right to review and update the guidelines at its sole discretion. Notice of such changes, if necessary, shall be provided in accordance with the terms and conditions of provider agreements and any applicable laws or regulations.

1.

Acharya AB, Fowler JB. Chaddock Reflex. StatPearls Publishing. Updated August 1, 2021. Accessed November 9, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK519555/>

2. Evidence Based Clinical Guidelines for Multidisciplinary Spine Care: Diagnosis and Treatment of Cervical Radiculopathy from Degenerative Disorders. North American Spine Society (NASS). Updated 2010. Accessed November 9, 2021.

<https://www.spine.org/Portals/0/Assets/Downloads/ResearchClinicalCare/Guidelines/CervicalRadiculopathy.pdf>

3. Bono CM, Ghiselli G, Gilbert TJ, et al. An evidence-based clinical guideline for the diagnosis and treatment of cervical radiculopathy from degenerative disorders. *Spine J.* Jan 2011;11(1):64-72. doi:10.1016/j.spinee.2010.10.023

4. Stolper K, Haug JC, Christensen CT, Samsey KM, April MD. Prevalence of thoracic spine lesions masquerading as cauda equina syndrome: yield of a novel magnetic resonance imaging protocol. *Intern Emerg Med.* Dec 2017;12(8):1259-1264. doi:10.1007/s11739-016-1565-9

5. Teoli D, Rocha Cabrero F, Ghassemzadeh S. Lhermitte Sign. StatPearls Publishing. Updated June 29, 2021. Accessed November 9, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK493237/>

6. Allegri M, Montella S, Salici F, et al. Mechanisms of low back pain: a guide for diagnosis and therapy. *F1000Res.* 2016;5doi:10.12688/f1000research.8105.2

7. American Association of Neurological Surgeons, Congress of Neurological Surgeons. Five things physicians and patients should question: Don't obtain imaging (plain radiographs, magnetic resonance imaging, computed tomography [CT], or other advanced imaging) of the spine in patients with non-specific acute low back pain and without red flags. Choosing Wisely Initiative ABIM Foundation.

- Updated 2020. Accessed November 9, 2021. <https://www.choosingwisely.org/clinician-lists/american-association-neurological-surgeons-imaging-for-nonspecific-acute-low-back-pain/>
8. Jarvik JG, Gold LS, Comstock BA, et al. Association of early imaging for back pain with clinical outcomes in older adults. *Jama*. Mar 17 2015;313(11):1143-53. doi:10.1001/jama.2015.1871
 9. Eubanks JD. Cervical radiculopathy: nonoperative management of neck pain and radicular symptoms. *Am Fam Physician*. Jan 1 2010;81(1):33-40.
 10. North American Spine Society. Five things physicians and patients should question: Don't use electromyography (EMG) and nerve conduction studies (NCS) to determine the cause of axial lumbar, thoracic or cervical spine pain. Choosing Wisely Initiative ABIM Foundation. Updated 2021. Accessed November 9, 2021. <https://www.choosingwisely.org/clinician-lists/nass-emg-nerve-conduction-studies-to-determine-cause-of-spine-pain/>
 11. Bernstein RM, Cozen H. Evaluation of back pain in children and adolescents. *Am Fam Physician*. Dec 1 2007;76(11):1669-76.
 12. Feldman DS, Straight JJ, Badra MI, Mohaideen A, Madan SS. Evaluation of an algorithmic approach to pediatric back pain. *J Pediatr Orthop*. May-Jun 2006;26(3):353-7. doi:10.1097/01.bpo.0000214928.25809.f9
 13. Rao D, Scuderi G, Scuderi C, Grewal R, Sandhu SJ. The Use of Imaging in Management of Patients with Low Back Pain. *J Clin Imaging Sci*. 2018;8:30. doi:10.4103/jcis.JCIS_16_18
 14. American College of Radiology. ACR Appropriateness Criteria® Cervical Neck Pain or Cervical Radiculopathy. American College of Radiology. Updated 2018. Accessed November 9, 2021. <https://acsearch.acr.org/docs/69426/Narrative/>
 15. Fisher BM, Cowles S, Matulich JR, Evanson BG, Vega D, Dissanaike S. Is magnetic resonance imaging in addition to a computed tomographic scan necessary to identify clinically significant cervical spine injuries in obtunded blunt trauma patients? *Am J Surg*. Dec 2013;206(6):987-93; discussion 993-4. doi:10.1016/j.amjsurg.2013.08.021
 16. Choi BW, Song KJ, Chang H. Ossification of the posterior longitudinal ligament: a review of literature. *Asian Spine J*. Dec 2011;5(4):267-76. doi:10.4184/asj.2011.5.4.267
 17. American College of Radiology. ACR Appropriateness Criteria® Myelopathy. American College of Radiology (ACR). Updated 2020. Accessed November 9, 2021. <https://acsearch.acr.org/docs/69484/Narrative/>
 18. Behrbalk E, Salame K, Regev GJ, Keynan O, Boszczyk B, Lidar Z. Delayed diagnosis of cervical spondylotic myelopathy by primary care physicians. *Neurosurg Focus*. Jul 2013;35(1):E1. doi:10.3171/2013.3.Focus1374
 19. Davies BM, Mowforth OD, Smith EK, Kotter MR. Degenerative cervical myelopathy. *Bmj*. Feb 22 2018;360:k186. doi:10.1136/bmj.k186
 20. Sarbu N, Lolli V, Smirniotopoulos JG. Magnetic resonance imaging in myelopathy: a pictorial review. *Clin Imaging*. Sep-Oct 2019;57:56-68. doi:10.1016/j.clinimag.2019.05.002
 21. de Oliveira Vilaca C, Orsini M, Leite MA, et al. Cervical Spondylotic Myelopathy: What the Neurologist Should Know. *Neurol Int*. Nov 2 2016;8(4):6330. doi:10.4081/ni.2016.6330
 22. Consortium of Multiple Sclerosis Centers. 2018 MRI Protocol and Clinical Guidelines for MS. Consortium of Multiple Sclerosis Centers (CMSC). Updated May 22, 2018. Accessed November 2, 2021. <https://www.ms-care.org/page/MRI-protocol>

23. Filippi M, Rocca MA, Ciccarelli O, et al. MRI criteria for the diagnosis of multiple sclerosis: MAGNIMS consensus guidelines. *Lancet Neurol.* Mar 2016;15(3):292–303. doi:10.1016/s1474-4422(15)00393-2
24. Kaunzner UW, Gauthier SA. MRI in the assessment and monitoring of multiple sclerosis: an update on best practice. *Ther Adv Neurol Disord.* Jun 2017;10(6):247–261. doi:10.1177/1756285617708911
25. Barakat N, Gorman MP, Benson L, Becerra L, Borsook D. Pain and spinal cord imaging measures in children with demyelinating disease. *Neuroimage Clin.* 2015;9:338–47. doi:10.1016/j.nicl.2015.08.019
26. Wingerchuk DM, Banwell B, Bennett JL, et al. International consensus diagnostic criteria for neuromyelitis optica spectrum disorders. *Neurology.* Jul 14 2015;85(2):177–89. doi:10.1212/wnl.0000000000001729
27. American College of Radiology. ACR Appropriateness Criteria® Suspected Spine Trauma American College of Radiology. Updated 2018. Accessed November 9, 2021. <https://acsearch.acr.org/docs/69359/Narrative/>
28. American College of Radiology. ACR Appropriateness Criteria® Inflammatory Back Pain: Known or Suspected Axial Spondyloarthritis. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3094107/Narrative/>
29. Koivikko MP, Koskinen SK. MRI of cervical spine injuries complicating ankylosing spondylitis. *Skeletal Radiol.* Sep 2008;37(9):813–9. doi:10.1007/s00256-008-0484-x
30. Taljanovic MS, Hunter TB, Wisneski RJ, et al. Imaging characteristics of diffuse idiopathic skeletal hyperostosis with an emphasis on acute spinal fractures: review. *AJR Am J Roentgenol.* Sep 2009;193(3 Suppl):S10–9, Quiz S20–4. doi:10.2214/ajr.07.7102
31. Alexandru D, So W. Evaluation and management of vertebral compression fractures. *Perm J.* Fall 2012;16(4):46–51. doi:10.7812/tpp/12-037
32. Kim YS, Han IH, Lee IS, Lee JS, Choi BK. Imaging findings of solitary spinal bony lesions and the differential diagnosis of benign and malignant lesions. *J Korean Neurosurg Soc.* 2012;52(2):126–132. doi:10.3340/jkns.2012.52.2.126
33. Roberts CC, Daffner RH, Weissman BN, et al. ACR appropriateness criteria on metastatic bone disease. *J Am Coll Radiol.* Jun 2010;7(6):400–9. doi:10.1016/j.jacr.2010.02.015
34. American College of Radiology. ACR Appropriateness Criteria® Neck Mass/Adenopathy. American College of Radiology. Updated 2018. Accessed November 9, 2021. <https://acsearch.acr.org/docs/69504/Narrative/>
35. Ziu E, Viswanathan VK, Mesfin FB. Spinal Metastasis. StatPearls Publishing. Updated August 27, 2021. Accessed November 10, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK441950/>
36. Bond A, Manian FA. Spinal Epidural Abscess: A Review with Special Emphasis on Earlier Diagnosis. *Biomed Res Int.* 2016;2016:1614328. doi:10.1155/2016/1614328
37. Berbari EF, Kanj SS, Kowalski TJ, et al. 2015 Infectious Diseases Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adults. *Clin Infect Dis.* Sep 15 2015;61(6):e26–46. doi:10.1093/cid/civ482
38. Colebatch AN, Edwards CJ, Østergaard M, et al. EULAR recommendations for the use of imaging of the joints in the clinical management of rheumatoid arthritis. *Ann Rheum Dis.* Jun 2013;72(6):804–14. doi:10.1136/annrheumdis-2012-203158
39. Mańczak M, Gasik R. Cervical spine instability in the course of rheumatoid arthritis—imaging methods. *Reumatologia.* 2017;55(4):201–207. doi:10.5114/reum.2017.69782

40. Gillick JL, Wainwright J, Das K. Rheumatoid Arthritis and the Cervical Spine: A Review on the Role of Surgery. *Int J Rheumatol*. 2015;2015:252456. doi:10.1155/2015/252456
41. Henderson FC, Sr., Austin C, Benzel E, et al. Neurological and spinal manifestations of the Ehlers-Danlos syndromes. *Am J Med Genet C Semin Med Genet*. Mar 2017;175(1):195-211. doi:10.1002/ajmg.c.31549
42. Nagashima H, Yamane K, Nishi T, Nanjo Y, Teshima R. Recent trends in spinal infections: retrospective analysis of patients treated during the past 50 years. *Int Orthop*. Mar 2010;34(3):395-9. doi:10.1007/s00264-009-0741-1
43. American College of Radiology. ACR Appropriateness Criteria® Suspected Spine Infection. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3148734/Narrative/>
44. Zalatio O. Tethered Spinal Cord Syndrome. American Association of Neurological Surgeons (AANS). Updated 2021. Accessed November 10, 2021. <https://www.aans.org/Patients/Neurosurgical-Conditions-and-Treatments/Tethered-Spinal-Cord-Syndrome>
45. Düz B, Gocmen S, Secer Hİ, Basal S, Gönül E. Tethered cord syndrome in adulthood. *J Spinal Cord Med*. 2008;31(3):272-8. doi:10.1080/10790268.2008.11760722
46. Milhorat TH, Bolognese PA, Nishikawa M, et al. Association of Chiari malformation type I and tethered cord syndrome: preliminary results of sectioning filum terminale. *Surg Neurol*. Jul 2009;72(1):20-35. doi:10.1016/j.surneu.2009.03.008
47. Whitson WJ, Lane JR, Bauer DF, Durham SR. A prospective natural history study of nonoperatively managed Chiari I malformation: does follow-up MRI surveillance alter surgical decision making? *J Neurosurg Pediatr*. Aug 2015;16(2):159-66. doi:10.3171/2014.12.Peds14301
48. Legare JM. Achondroplasia. University of Washington, Seattle. Updated August 6, 2020. Accessed November 10, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK1152/>
49. White KK, Bompadre V, Goldberg MJ, et al. Best practices in the evaluation and treatment of foramen magnum stenosis in achondroplasia during infancy. *Am J Med Genet A*. Jan 2016;170a(1):42-51. doi:10.1002/ajmg.a.37394
50. Timpone VM, Patel SH. MRI of a syrinx: is contrast material always necessary? *AJR Am J Roentgenol*. May 2015;204(5):1082-5. doi:10.2214/ajr.14.13310
51. American College of Radiology. ACR Appropriateness Criteria® Headache. American College of Radiology. Updated 2019. Accessed November 1, 2021. <https://acsearch.acr.org/docs/69482/Narrative/>
52. American College of Radiology. ACR Appropriateness Criteria® Headache Child. American College of Radiology. Updated 2017. Accessed November 10, 2021. <https://acsearch.acr.org/docs/69439/Narrative/>
53. American College of Radiology. ACR Appropriateness Criteria® Scoliosis Child. American College of Radiology. Updated 2018. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3101564/Narrative/>
54. Juvenile Scoliosis. Scoliosis Research Society (SRS). Updated 2021. Accessed November 10, 2021. <https://www.srs.org/professionals/online-education-and-resources/conditions-and-treatments/juvenile-scoliosis>
55. Strahle J, Smith BW, Martinez M, et al. The association between Chiari malformation Type I, spinal syrinx, and scoliosis. *J Neurosurg Pediatr*. Jun 2015;15(6):607-11. doi:10.3171/2014.11.Peds14135

56. Trenga AP, Singla A, Feger MA, Abel MF. Patterns of congenital bony spinal deformity and associated neural anomalies on X-ray and magnetic resonance imaging. *J Child Orthop*. Aug 2016;10(4):343–52. doi:10.1007/s11832-016-0752-6
57. Ozturk C, Karadereler S, Ornek I, Enercan M, Ganiyusufoglu K, Hamzaoglu A. The role of routine magnetic resonance imaging in the preoperative evaluation of adolescent idiopathic scoliosis. *Int Orthop*. Apr 2010;34(4):543–6. doi:10.1007/s00264-009-0817-y
58. Radic JAE, Cochrane DD. Choosing Wisely Canada: Pediatric Neurosurgery Recommendations. *Paediatr Child Health*. Sep 2018;23(6):383–387. doi:10.1093/pch/pxy012
59. Strahle J, Muraszko KM, Kapurch J, Bapuraj JR, Garton HJ, Maher CO. Chiari malformation Type I and syrinx in children undergoing magnetic resonance imaging. *J Neurosurg Pediatr*. Aug 2011;8(2):205–13. doi:10.3171/2011.5.Peds1121
60. Hertzler DA, 2nd, DePowell JJ, Stevenson CB, Mangano FT. Tethered cord syndrome: a review of the literature from embryology to adult presentation. *Neurosurg Focus*. Jul 2010;29(1):E1. doi:10.3171/2010.3.Focus1079
61. Shah LM, Salzman KL. Imaging of spinal metastatic disease. *Int J Surg Oncol*. 2011;2011:769753. doi:10.1155/2011/769753
62. Last AR, Hulbert K. Chronic low back pain: evaluation and management. *Am Fam Physician*. Jun 15 2009;79(12):1067–74.
63. American College of Radiology. ACR Appropriateness Criteria® Low Back Pain. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/69483/Narrative/>
64. Graeber A, Cecava ND. Vertebral Osteomyelitis. StatPearls Publishing. Updated July 22, 2021. Accessed November 10, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK532256/>
65. Chhetri SK, Gow D, Shaunak S, Varma A. Clinical assessment of the sensory ataxias; diagnostic algorithm with illustrative cases. *Pract Neurol*. Aug 2014;14(4):242–51. doi:10.1136/practneurol-2013-000764
66. Foster H, Drummond P, Jandial S, Clinch J, Wood M, Driscoll S. Evaluation of gait disorders in children. BMJ Best Practice. Updated February 23, 2021. Accessed November 2, 2021. <https://bestpractice.bmj.com/topics/en-us/709>
67. Stanford Medicine. Gait Abnormalities. Stanford University. Updated 2021. Accessed November 2, 2021. <https://stanfordmedicine25.stanford.edu/the25/gait.html>
68. Haynes KB, Wimberly RL, VanPelt JM, Jo CH, Riccio AI, Delgado MR. Toe Walking: A Neurological Perspective After Referral From Pediatric Orthopaedic Surgeons. *J Pediatr Orthop*. Mar 2018;38(3):152–156. doi:10.1097/bpo.0000000000001115
69. Marshall FJ. Approach to the elderly patient with gait disturbance. *Neurol Clin Pract*. Jun 2012;2(2):103–111. doi:10.1212/CPJ.0b013e31825a7823
70. Pirker W, Katzenschlager R. Gait disorders in adults and the elderly : A clinical guide. *Wien Klin Wochenschr*. Feb 2017;129(3–4):81–95. doi:10.1007/s00508-016-1096-4
71. Dias M, Partington M. Congenital Brain and Spinal Cord Malformations and Their Associated Cutaneous Markers. *Pediatrics*. Oct 2015;136(4):e1105–19. doi:10.1542/peds.2015-2854
72. American College of Radiology. ACR Appropriateness Criteria® Management of Vertebral Compression Fractures. American College of Radiology. Updated 2018. Accessed November 10, 2021. <https://acsearch.acr.org/docs/70545/Narrative/>

73. Borofsky S, Levy LM. Neurofibromatosis: types 1 and 2. *AJNR Am J Neuroradiol*. Dec 2013;34(12):2250-1. doi:10.3174/ajnr.A3534
74. Evans DGR, Salvador H, Chang VY, et al. Cancer and Central Nervous System Tumor Surveillance in Pediatric Neurofibromatosis 2 and Related Disorders. *Clin Cancer Res*. Jun 15 2017;23(12):e54-e61. doi:10.1158/1078-0432.Ccr-17-0590
75. Krueger DA, Northrup H. Tuberous sclerosis complex surveillance and management: recommendations of the 2012 International Tuberous Sclerosis Complex Consensus Conference. *Pediatr Neurol*. Oct 2013;49(4):255-65. doi:10.1016/j.pediatrneurol.2013.08.002
76. Varshney N, Kebede AA, Owusu-Dapaah H, Lather J, Kaushik M, Bhullar JS. A Review of Von Hippel-Lindau Syndrome. *J Kidney Cancer VHL*. 2017;4(3):20-29. doi:10.15586/jkcvhl.2017.88
77. Comi AM. Presentation, diagnosis, pathophysiology, and treatment of the neurological features of Sturge-Weber syndrome. *Neurologist*. Jul 2011;17(4):179-84. doi:10.1097/NRL.0b013e318220c5b6
1. Acharya AB, Fowler JB. Chaddock Reflex. StatPearls Publishing. Updated August 1, 2021. Accessed November 9, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK519555/>
2. Evidence-Based Clinical Guidelines for Multidisciplinary Spine Care: Diagnosis and Treatment of Cervical Radiculopathy from Degenerative Disorders. North American Spine Society (NASS). Updated 2010. Accessed November 9, 2021. <https://www.spine.org/Portals/0/Assets/Downloads/ResearchClinicalCare/Guidelines/CervicalRadiculopathy.pdf>
3. Bono CM, Ghiselli G, Gilbert TJ, et al. An evidence-based clinical guideline for the diagnosis and treatment of cervical radiculopathy from degenerative disorders. *Spine J*. Jan 2011;11(1):64-72. doi:10.1016/j.spinee.2010.10.023
4. Stolper K, Haug JC, Christensen CT, Samsey KM, April MD. Prevalence of thoracic spine lesions masquerading as cauda equina syndrome: yield of a novel magnetic resonance imaging protocol. *Intern Emerg Med*. Dec 2017;12(8):1259-1264. doi:10.1007/s11739-016-1565-9
5. Teoli D, Rocha Cabrero F, Ghassemzadeh S. Lhermitte Sign. StatPearls Publishing. Updated June 29, 2021. Accessed November 9, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK493237/>
6. Albert TJ, Murrell SE. Surgical management of cervical radiculopathy. *J Am Acad Orthop Surg*. Nov-Dec 1999;7(6):368-76. doi:10.5435/00124635-199911000-00003
7. Allegri M, Montella S, Salici F, et al. Mechanisms of low back pain: a guide for diagnosis and therapy. *F1000Res*. 2016;5doi:10.12688/f1000research.8105.2
8. American Association of Neurological Surgeons, Congress of Neurological Surgeons. Five things physicians and patients should question: Don't obtain imaging (plain radiographs, magnetic resonance imaging, computed tomography [CT], or other advanced imaging) of the spine in patients with non-specific acute low back pain and without red flags. Choosing Wisely Initiative ABIM Foundation. Updated 2020. Accessed November 9, 2021. <https://www.choosingwisely.org/clinician-lists/american-association-neurological-surgeons-imaging-for-nonspecific-acute-low-back-pain/>
9. Jarvik JG, Gold LS, Comstock BA, et al. Association of early imaging for back pain with clinical outcomes in older adults. *Jama*. Mar 17 2015;313(11):1143-53. doi:10.1001/jama.2015.1871
10. Eubanks JD. Cervical radiculopathy: nonoperative management of neck pain and radicular symptoms. *Am Fam Physician*. Jan 1 2010;81(1):33-40.
11. North American Spine Society. Five things physicians and patients should question: Don't use electromyography (EMG) and nerve conduction studies (NCS) to determine the cause of axial lumbar, thoracic or cervical spine pain. Choosing Wisely Initiative ABIM Foundation. Updated 2021. Accessed

November 9, 2021. <https://www.choosingwisely.org/clinician-lists/nass-emg-nerve-conduction-studies-to-determine-cause-of-spine-pain/>

12. American College of Radiology. ACR Appropriateness Criteria® Cervical Neck Pain or Cervical Radiculopathy. American College of Radiology. Updated 2018. Accessed November 9, 2021.

<https://acsearch.acr.org/docs/69426/Narrative/>

13. American College of Radiology. ACR Appropriateness Criteria® Back Pain—Child. American College of Radiology (ACR). Updated 2016. Accessed November 10, 2021.

<https://acsearch.acr.org/docs/3099011/Narrative/>

14. Bernstein RM, Cozen H. Evaluation of back pain in children and adolescents. *Am Fam Physician*. Dec 1 2007;76(11):1669-76.

15. Feldman DS, Straight JJ, Badra MI, Mohaideen A, Madan SS. Evaluation of an algorithmic approach to pediatric back pain. *J Pediatr Orthop*. May-Jun 2006;26(3):353-7.

doi:10.1097/01.bpo.0000214928.25809.f9

16. Rao D, Scuderi G, Scuderi C, Grewal R, Sandhu SJ. The Use of Imaging in Management of Patients with Low Back Pain. *J Clin Imaging Sci*. 2018;8:30. doi:10.4103/jcis.JCIS_16_18

17. Corona-Cedillo R, Saavedra-Navarrete MT, Espinoza-Garcia JJ, Mendoza-Aguilar AN, Ternovoy SK, Roldan-Valadez E. Imaging Assessment of the Postoperative Spine: An Updated Pictorial Review of Selected Complications. *Biomed Res Int*. 2021;2021:9940001. doi:10.1155/2021/9940001

18. Fisher BM, Cowles S, Matulich JR, Evanson BG, Vega D, Dissanaik S. Is magnetic resonance imaging in addition to a computed tomographic scan necessary to identify clinically significant cervical spine injuries in obtunded blunt trauma patients? *Am J Surg*. Dec 2013;206(6):987-93; discussion 993-4. doi:10.1016/j.amjsurg.2013.08.021

19. Choi BW, Song KJ, Chang H. Ossification of the posterior longitudinal ligament: a review of literature. *Asian Spine J*. Dec 2011;5(4):267-76. doi:10.4184/asj.2011.5.4.267

20. American College of Radiology. ACR Appropriateness Criteria® Myelopathy. American College of Radiology (ACR). Updated 2020. Accessed November 9, 2021.

<https://acsearch.acr.org/docs/69484/Narrative/>

21. Behrbalk E, Salame K, Regev GJ, Keynan O, Boszczyk B, Lidar Z. Delayed diagnosis of cervical spondylotic myelopathy by primary care physicians. *Neurosurg Focus*. Jul 2013;35(1):E1.

doi:10.3171/2013.3.Focus1374

22. Davies BM, Mowforth OD, Smith EK, Kotter MR. Degenerative cervical myelopathy. *Bmj*. Feb 22 2018;360:k186. doi:10.1136/bmj.k186

23. Sarbu N, Lolli V, Smirniotopoulos JG. Magnetic resonance imaging in myelopathy: a pictorial review. *Clin Imaging*. Sep-Oct 2019;57:56-68. doi:10.1016/j.clinimag.2019.05.002

24. de Oliveira Vilaça C, Orsini M, Leite MA, et al. Cervical Spondylotic Myelopathy: What the Neurologist Should Know. *Neurol Int*. Nov 2 2016;8(4):6330. doi:10.4081/ni.2016.6330

25. Consortium of Multiple Sclerosis Centers. 2018 MRI Protocol and Clinical Guidelines for MS. Consortium of Multiple Sclerosis Centers (CMSC). Updated May 22, 2018. Accessed November 2, 2021.

https://www.msca.org/page/MRI_protocol

26. Filippi M, Rocca MA, Ciccarelli O, et al. MRI criteria for the diagnosis of multiple sclerosis: MAGNIMS consensus guidelines. *Lancet Neurol*. Mar 2016;15(3):292-303. doi:10.1016/s1474-4422(15)00393-2

27. Kaunzner UW, Gauthier SA. MRI in the assessment and monitoring of multiple sclerosis: an update on best practice. *Ther Adv Neurol Disord*. Jun 2017;10(6):247-261. doi:10.1177/1756285617708911

28. Barakat N, Gorman MP, Benson L, Becerra L, Borsook D. Pain and spinal cord imaging measures in children with demyelinating disease. *Neuroimage Clin*. 2015;9:338-47. doi:10.1016/j.nicl.2015.08.019
29. Wingerchuk DM, Banwell B, Bennett JL, et al. International consensus diagnostic criteria for neuromyelitis optica spectrum disorders. *Neurology*. Jul 14 2015;85(2):177-89. doi:10.1212/wnl.0000000000001729
30. American College of Radiology. ACR Appropriateness Criteria® Suspected Spine Trauma American College of Radiology. Updated 2018. Accessed November 9, 2021. <https://acsearch.acr.org/docs/69359/Narrative/>
31. American College of Radiology. ACR Appropriateness Criteria® Inflammatory Back Pain: Known or Suspected Axial Spondyloarthritis. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3094107/Narrative/>
32. Koivikko MP, Koskinen SK. MRI of cervical spine injuries complicating ankylosing spondylitis. *Skeletal Radiol*. Sep 2008;37(9):813-9. doi:10.1007/s00256-008-0484-x
33. Taljanovic MS, Hunter TB, Wisneski RJ, et al. Imaging characteristics of diffuse idiopathic skeletal hyperostosis with an emphasis on acute spinal fractures: review. *AJR Am J Roentgenol*. Sep 2009;193(3 Suppl):S10-9, Quiz S20-4. doi:10.2214/ajr.07.7102
34. Alexandru D, So W. Evaluation and management of vertebral compression fractures. *Perm J*. Fall 2012;16(4):46-51. doi:10.7812/tpp/12-037
35. Kim YS, Han IH, Lee IS, Lee JS, Choi BK. Imaging findings of solitary spinal bony lesions and the differential diagnosis of benign and malignant lesions. *J Korean Neurosurg Soc*. 2012;52(2):126-132. doi:10.3340/jkns.2012.52.2.126
36. Roberts CC, Daffner RH, Weissman BN, et al. ACR appropriateness criteria on metastatic bone disease. *J Am Coll Radiol*. Jun 2010;7(6):400-9. doi:10.1016/j.jacr.2010.02.015
37. American College of Radiology. ACR Appropriateness Criteria® Neck Mass/Adenopathy. American College of Radiology. Updated 2018. Accessed November 9, 2021. <https://acsearch.acr.org/docs/69504/Narrative/>
38. NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines): Central Nervous System Cancers Version 2.2021. National Comprehensive Cancer Network (NCCN). Updated September 8, 2021. Accessed February 22, 2022. https://www.nccn.org/professionals/physician_gls/pdf/cns.pdf
39. Ziu E, Viswanathan VK, Mesfin FB. Spinal Metastasis. StatPearls Publishing. Updated August 27, 2021. Accessed November 10, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK441950/>
40. Bond A, Manian FA. Spinal Epidural Abscess: A Review with Special Emphasis on Earlier Diagnosis. *Biomed Res Int*. 2016;2016:1614328. doi:10.1155/2016/1614328
41. Berbari EF, Kanj SS, Kowalski TJ, et al. 2015 Infectious Diseases Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adults. *Clin Infect Dis*. Sep 15 2015;61(6):e26-46. doi:10.1093/cid/civ482
42. Colebatch AN, Edwards CJ, Østergaard M, et al. EULAR recommendations for the use of imaging of the joints in the clinical management of rheumatoid arthritis. *Ann Rheum Dis*. Jun 2013;72(6):804-14. doi:10.1136/annrheumdis-2012-203158
43. Mańczak M, Gasik R. Cervical spine instability in the course of rheumatoid arthritis - imaging methods. *Reumatologia*. 2017;55(4):201-207. doi:10.5114/reum.2017.69782
44. Gillick JL, Wainwright J, Das K. Rheumatoid Arthritis and the Cervical Spine: A Review on the Role of Surgery. *Int J Rheumatol*. 2015;2015:252456. doi:10.1155/2015/252456

45. Henderson FC, Sr., Austin C, Benzel E, et al. Neurological and spinal manifestations of the Ehlers-Danlos syndromes. *Am J Med Genet C Semin Med Genet*. Mar 2017;175(1):195-211. doi:10.1002/ajmg.c.31549
46. Nagashima H, Yamane K, Nishi T, Nanjo Y, Teshima R. Recent trends in spinal infections: retrospective analysis of patients treated during the past 50 years. *Int Orthop*. Mar 2010;34(3):395-9. doi:10.1007/s00264-009-0741-1
47. American College of Radiology. ACR Appropriateness Criteria® Suspected Spine Infection. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3148734/Narrative/>
48. Zalatio O. Tethered Spinal Cord Syndrome. American Association of Neurological Surgeons (AANS). Updated 2021. Accessed November 10, 2021. <https://www.aans.org/Patients/Neurosurgical-Conditions-and-Treatments/Tethered-Spinal-Cord-Syndrome>
49. Düz B, Gocmen S, Secer HI, Basal S, Gönül E. Tethered cord syndrome in adulthood. *J Spinal Cord Med*. 2008;31(3):272-8. doi:10.1080/10790268.2008.11760722
50. Milhorat TH, Bolognese PA, Nishikawa M, et al. Association of Chiari malformation type I and tethered cord syndrome: preliminary results of sectioning filum terminale. *Surg Neurol*. Jul 2009;72(1):20-35. doi:10.1016/j.surneu.2009.03.008
51. Whitson WJ, Lane JR, Bauer DF, Durham SR. A prospective natural history study of nonoperatively managed Chiari I malformation: does follow-up MRI surveillance alter surgical decision making? *J Neurosurg Pediatr*. Aug 2015;16(2):159-66. doi:10.3171/2014.12.Peds14301
52. Legare JM. Achondroplasia. University of Washington, Seattle. Updated August 6, 2020. Accessed November 10, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK1152/>
53. White KK, Bompadre V, Goldberg MJ, et al. Best practices in the evaluation and treatment of foramen magnum stenosis in achondroplasia during infancy. *Am J Med Genet A*. Jan 2016;170a(1):42-51. doi:10.1002/ajmg.a.37394
54. Timpone VM, Patel SH. MRI of a syrinx: is contrast material always necessary? *AJR Am J Roentgenol*. May 2015;204(5):1082-5. doi:10.2214/ajr.14.13310
55. American College of Radiology. ACR Appropriateness Criteria® Headache. American College of Radiology. Updated 2019. Accessed November 1, 2021. <https://acsearch.acr.org/docs/69482/Narrative/>
56. American College of Radiology. ACR Appropriateness Criteria® Headache-Child. American College of Radiology. Updated 2017. Accessed November 10, 2021. <https://acsearch.acr.org/docs/69439/Narrative/>
57. Strahle J, Smith BW, Martinez M, et al. The association between Chiari malformation Type I, spinal syrinx, and scoliosis. *J Neurosurg Pediatr*. Jun 2015;15(6):607-11. doi:10.3171/2014.11.Peds14135
58. Juvenile Scoliosis. Scoliosis Research Society (SRS). Updated 2021. Accessed November 10, 2021. <https://www.srs.org/professionals/online-education-and-resources/conditions-and-treatments/juvenile-scoliosis>
59. American College of Radiology. ACR Appropriateness Criteria® Scoliosis-Child. American College of Radiology. Updated 2018. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3101564/Narrative/>
60. Trenga AP, Singla A, Feger MA, Abel MF. Patterns of congenital bony spinal deformity and associated neural anomalies on X-ray and magnetic resonance imaging. *J Child Orthop*. Aug 2016;10(4):343-52. doi:10.1007/s11832-016-0752-6

61. Ozturk C, Karadereler S, Ornek I, Enercan M, Ganiyusufoglu K, Hamzaoglu A. The role of routine magnetic resonance imaging in the preoperative evaluation of adolescent idiopathic scoliosis. *Int Orthop*. Apr 2010;34(4):543-6. doi:10.1007/s00264-009-0817-y
62. Strahle J, Muraszko KM, Kapurch J, Bapuraj JR, Garton HJ, Maher CO. Chiari malformation Type I and syrinx in children undergoing magnetic resonance imaging. *J Neurosurg Pediatr*. Aug 2011;8(2):205-13. doi:10.3171/2011.5.Peds1121
63. Radic JAE, Cochrane DD. Choosing Wisely Canada: Pediatric Neurosurgery Recommendations. *Paediatr Child Health*. Sep 2018;23(6):383-387. doi:10.1093/pch/pxy012
64. Hertzler DA, 2nd, DePowell JJ, Stevenson CB, Mangano FT. Tethered cord syndrome: a review of the literature from embryology to adult presentation. *Neurosurg Focus*. Jul 2010;29(1):E1. doi:10.3171/2010.3.Focus1079
65. Shah LM, Salzman KL. Imaging of spinal metastatic disease. *Int J Surg Oncol*. 2011;2011:769753. doi:10.1155/2011/769753
66. Last AR, Hulbert K. Chronic low back pain: evaluation and management. *Am Fam Physician*. Jun 15 2009;79(12):1067-74.
67. American College of Radiology. ACR Appropriateness Criteria® Low Back Pain. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/69483/Narrative/>
68. Graeber A, Cecava ND. Vertebral Osteomyelitis. StatPearls Publishing. Updated July 22, 2021. Accessed November 10, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK532256/>
69. Chhetri SK, Gow D, Shaunak S, Varma A. Clinical assessment of the sensory ataxias; diagnostic algorithm with illustrative cases. *Pract Neurol*. Aug 2014;14(4):242-51. doi:10.1136/practneurol-2013-000764
70. Foster H, Drummond P, Jandial S, Clinch J, Wood M, Driscoll S. Evaluation of gait disorders in children. BMJ Best Practice. Updated February 23, 2021. Accessed November 2, 2021. <https://bestpractice.bmj.com/topics/en-us/709>
71. Stanford Medicine. Gait Abnormalities. Stanford University. Updated 2021. Accessed November 2, 2021. <https://stanfordmedicine25.stanford.edu/the25/gait.html>
72. Haynes KB, Wimberly RL, VanPelt JM, Jo CH, Riccio AI, Delgado MR. Toe Walking: A Neurological Perspective After Referral From Pediatric Orthopaedic Surgeons. *J Pediatr Orthop*. Mar 2018;38(3):152-156. doi:10.1097/bpo.0000000000001115
73. Marshall FJ. Approach to the elderly patient with gait disturbance. *Neurol Clin Pract*. Jun 2012;2(2):103-111. doi:10.1212/CPJ.0b013e31825a7823
74. Pirker W, Katzenschlager R. Gait disorders in adults and the elderly : A clinical guide. *Wien Klin Wochenschr*. Feb 2017;129(3-4):81-95. doi:10.1007/s00508-016-1096-4
75. Dias M, Partington M. Congenital Brain and Spinal Cord Malformations and Their Associated Cutaneous Markers. *Pediatrics*. Oct 2015;136(4):e1105-19. doi:10.1542/peds.2015-2854
76. American College of Radiology. ACR Appropriateness Criteria® Management of Vertebral Compression Fractures. American College of Radiology. Updated 2018. Accessed November 10, 2021. <https://acsearch.acr.org/docs/70545/Narrative/>
77. Borofsky S, Levy LM. Neurofibromatosis: types 1 and 2. *AJNR Am J Neuroradiol*. Dec 2013;34(12):2250-1. doi:10.3174/ajnr.A3534

78. Evans DGR, Salvador H, Chang VY, et al. Cancer and Central Nervous System Tumor Surveillance in Pediatric Neurofibromatosis 2 and Related Disorders. *Clin Cancer Res*. Jun 15 2017;23(12):e54-e61. doi:10.1158/1078-0432.Ccr-17-0590
79. Krueger DA, Northrup H. Tuberous sclerosis complex surveillance and management: recommendations of the 2012 International Tuberous Sclerosis Complex Consensus Conference. *Pediatr Neurol*. Oct 2013;49(4):255-65. doi:10.1016/j.pediatrneurol.2013.08.002
80. Varshney N, Kebede AA, Owusu-Dapaah H, Lather J, Kaushik M, Bhullar JS. A Review of Von Hippel-Lindau Syndrome. *J Kidney Cancer VHL*. 2017;4(3):20-29. doi:10.15586/jkcvhl.2017.88
81. Comi AM. Presentation, diagnosis, pathophysiology, and treatment of the neurological features of Sturge-Weber syndrome. *Neurologist*. Jul 2011;17(4):179-84. doi:10.1097/NRL.0b013e318220c5b6
82. Ahmed A. MRI features of disseminated 'drop metastases'. *S Afr Med J*. Jul 2008;98(7):522-3.
83. Batool A, Kasi A. Leptomenigeal Carcinomatosis. StatPearls Publishing
Copyright © 2022, StatPearls Publishing LLC. Updated March 25, 2021. Accessed February 25, 2022. <https://www.ncbi.nlm.nih.gov/books/NBK499862/>

ADDITIONAL RESOURCES

1. AIUM Practice Parameter for the Performance of an Ultrasound Examination of the Neonatal and Infant Spine. *Journal of Ultrasound in Medicine*. 2016;35(9):1-11. doi:<https://doi.org/10.7863/jum.2016.35.9.3>
2. Braga-Baiak A, Shah A, Pietrobon R, Braga L, Neto AC, Cook C. Intra- and inter-observer reliability of MRI examination of intervertebral disc abnormalities in patients with cervical myelopathy. *Eur J Radiol*. Jan 2008;65(1):91-8. doi:10.1016/j.ejrad.2007.04.014
3. Choi JH, Lee T, Kwon HH, You SK, Kang JW. Outcome of ultrasonographic imaging in infants with sacral dimple. *Korean J Pediatr*. Jun 2018;61(6):194-199. doi:10.3345/kjp.2018.61.6.194
4. D'Alessandro DM. Does This Sacral Dimple Need to be Evaluated? *PediatricEducation.org*™. Updated July 20, 2009. Accessed November 10, 2021. <https://pediatriceducation.org/2009/07/20/does-this-sacral-dimple-need-to-be-evaluated/>
5. Diab M, Landman Z, Lubicky J, Dormans J, Erickson M, Richards BS. Use and outcome of MRI in the surgical treatment of adolescent idiopathic scoliosis. *Spine (Phila Pa 1976)*. Apr 15 2011;36(8):667-71. doi:10.1097/BRS.0b013e3181da218c
6. Dow G, Biggs N, Evans G, Gillespie J, Ramsden R, King A. Spinal tumors in neurofibromatosis type 2. Is emerging knowledge of genotype predictive of natural history? *J Neurosurg Spine*. May 2005;2(5):574-9. doi:10.3171/spi.2005.2.5.0574
7. Goh C, Phal PM, Desmond PM. Neuroimaging in acute transverse myelitis. *Neuroimaging Clin N Am*. Nov 2011;21(4):951-73, x. doi:10.1016/j.nic.2011.07.010
8. Jensen A, Jacobsen JB, Nørgaard M, Yong M, Fryzek JP, Sørensen HT. Incidence of bone metastases and skeletal-related events in breast cancer patients: a population-based cohort study in Denmark. *BMC Cancer*. Jan 24 2011;11:29. doi:10.1186/1471-2407-11-29
9. Kumar Y, Hayashi D. Role of magnetic resonance imaging in acute spinal trauma: a pictorial review. *BMC Musculoskelet Disord*. Jul 22 2016;17:310. doi:10.1186/s12891-016-1169-6

10. North American Spine Society. Five things physicians and patients should question. Choosing Wisely Initiative ABIM Foundation. Updated 2021. Accessed November 9, 2021.

<https://www.choosingwisely.org/societies/north-american-spine-society/>

11. Rednam SP, Erez A, Druker H, et al. Von Hippel-Lindau and Hereditary Pheochromocytoma/Paraganglioma Syndromes: Clinical Features, Genetics, and Surveillance Recommendations in Childhood. *Clin Cancer Res*. Jun 15 2017;23(12):e68-e75. doi:10.1158/1078-0432.Ccr-17-0547

[Reviewed / Approved by NIA Clinical Guideline Committee](#)

GENERAL INFORMATION

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.

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